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Susceptibility antibiotics of bacteria causing urinary tract infection in pregnant women infect with diabetic

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Abstract
Background: Diabetes mellitus predisposes the genitourinary system and weakens the host's immune system which leads to chances of being infected such as the UTI.
Objective: To determine the bacterial profile and antibiotic resistance profile of urinary tract infections (UTIs) among pregnant woman with Diabetes mellitus (DM).
Methodology: The samples of urine were collected from 201 type 2 DM women with confirmed UTI. Steriely and biologically. The susceptibility of antibiotics was done on the isolated bacterial species through the use of the Kirby-Bauer disk diffusion method.
Results: The study revealed that pregnant women between the age of 18-30 years had a relatively high likelihood of developing a UTI than the 30 + group. Out of the participants who were sampled 41.6% were found to have pathogenic bacterial that infect humans. Relative to the antibiotic sensitivity, 89.0% of the isolated organisms were highly sensitive to Nitrofurantoin and 84.5% were sensitive to Gentamicin. Additionally, the following antibiotics exhibited varying levels of effectiveness against the isolates: Cefixime= 83.6% Amikacin= 84.0%, Levofloxacin= 77.2%, Co-trimoxazole= 72.1%, Ceftriaxone= 70.8%, Azithromycin= 62.0%. However, other antibiotics were less sensitive and included; Ciprofloxacin with sensitivity of 47.2%, Ceftazidime with sensitivity of 41.3%, and Amoxicillin with a sensitivity of 27.5%. However,
Conclusion: This study also shows the significance of studying the bacterial profile and their resistance profiles to the UTI in pregnant women with diabetes so that the management treatment and prevention can be effectively improved to decrease the threats related to antibiotic resistance.

Keywords: Susceptibility antibiotics, pregnant women, diabetic, urinary tract infections

Introduction

Urinary tract infections (UTIs) are among the most prevalent bacterial diseases affecting women worldwide, and their severity is significantly exacerbated during pregnancy [1, 2]. This clinical challenge becomes increasingly critical when occurring in pregnant women diagnosed with diabetes mellitus. High glucose levels in the blood and tissues, coupled with the physiological and immunological changes inherent to pregnancy, create an environment highly conducive to the proliferation of pathogenicmicroorganisms [3, 4]. The confluence of pregnancy and diabetespresents a complex clinical scenario; diabetes not only impairs immune system responsiveness but also affects urinary tract functionality through diabetic neuropathy and impaired bladder emptying, thereby increasing the likelihood of urinary stasis, which facilitates bacterial colonization [5, 6]. Global projections indicate a continuous rise in the prevalence of diabetes, with the number of affected individuals expected to reach hundreds of millions in the coming decades. This trend foreshadows a corresponding increase in diabetes-associated infections, including UTIs [7]. Recent studies in 2025 [34] and 2026emphasize that the synergy between metabolic dysfunction and gestational physiology significantly shifts the microbiome, often promoting the selection of high-virulence, resistant strains [8, 9].

The significance of studying this condition extends beyond the patient's immediate discomfort and pain; it encompasses severe risks to both maternal and fetal health, such as preterm birth, low birth weight, and pyelonephritis, placing a substantial therapeutic burden on healthcare providers [10]. Concurrently, the excessive and irrational use of antibiotics to treat these infections constitutes a global crisis characterized by the emergence of multidrugresistant (MDR) bacterial strains, rendering traditional therapeutic protocols increasingly ineffective [11, 12]. Contemporary research highlights that Extended-Spectrum Beta-Lactamase (ESBL)-producing organisms are rising alarmingly in obstetric populations, necessitating a paradigm shift toward targeted, rather than purely empiric, treatment strategies [13]. Shifting patterns in antibiotic susceptibility necessitate continuous field studies to identify common bacterial pathogens and their sensitivity to available antibiotics in specific geographical regions. This is essential to ensure the selection of optimal empiric therapy prior to obtaining final laboratory culture results [14, 15].

Understanding the bacterial profile in this high-risk group is not merely an academic exercise but a clinical imperative to improve therapeutic outcomes, mitigate bacterial resistance rates, and reduce complications associated with both pregnancy and diabetes [16]. By implementing rigorous laboratory standards, reliable data will be provided to support physicians in making evidence-based decisions, ensure the safety of the mother and fetus, and alleviate the economic and health burdens resulting from the improper management of recurrent and treatment-resistant infections [16, 17]. These studies contribute to updating prevention and clinical management protocols, thereby reducing the risk of

community- or hospital-acquired infections and enhancing the quality of healthcare provided to this population [11, 14]. Ultimately, this research represents a fundamental step toward developing a more precise and effective therapeutic approach, grounded in a deep understanding of the evolving bacterial environment in the presence of diabetes as an additional risk factor during pregnancy [18, 19]. This study aims to elucidate the clinical reality of this issue within a specific clinical environment, seeking to characterize the microbial distribution of pathogens and their antibiotic susceptibility profiles in pregnant women with diabetes.

Methodology

Sample collection

A total of 201 urine samples were collected from pregnant women with diabetes and categorized into three age groups: the first was comprised of women (18-30) years and the second group was women aged (31-35) years at Teaching Hospital in Maysan City, Iraq. Mid-stream urine samples were obtained in sterilized test tubes from the extended period of February to July of the 2025.

Inclusion criteria

Eligibility criteria included collection of adequate midstream clean-catch urine sample and consent to be included in the study. All were eligible irrespective of whether they had any symptoms or not, as long as there was a urine sample available for microbiological examination. Urine culture was considered positive for bacteria and these were used for the antimicrobial susceptibility analysis.

Exclusion criteria

Urine samples were excluded if the woman had received antibiotics within the last 14 days or if the urine sample was contaminated, inadequate, duplicate or weren't handled correctly or she was not pregnant or had a confirmed case of diabetes mellitus. Where possible, women who had urinary catheters or a known structural abnormality of the urinary tract which might interfere with interpretation of the culture results were also excluded.

Microscopic examination and all urine samples

All samples were analyzed microscopically with special reference to those with pus, these samples were cultured on nutrient agar, MacConkey agar, 5% blood agar and mannitol salt agar and after incubation aerobically at 37 °C for 24 hours. Initially, colonies were identified based on the phenotype and culture characteristics. The identification of the isolated bacteria was accomplished via standard microbiological methods. Including cultural traits, and those who had gram-negative bacteria were diagnosed by the VITEK 2 Compact Automated System with cards based on the instructions of the manufacturer.

Antibiotic sensitivity test

Antipathogen susceptibility tests were conducted using the Kirby-Bauer method of disk diffusion recommended by the Clinical and Laboratory Standards Institute (CLSI) [20] . As with all methods which are used in the cascade test, all elements of the Kirby–Bauer method are normalized to ensure accuracy of the results. The medium employed here is Mueller-Hinton agar, which is of 4mm thickness and the Petri dishes used are of 100 mm size. The pH of the agar should be approximately (7.2-7.4). The bacterial inoculum is prepared by adjusting a broths culture to its density which is comparable to the McFarland 0.5 density [21]. The antibiotics which were used and tested include; Amikacin (30 µg), Amoxicillin (25 µg), Ampicillin (10 µg), Ceftriaxone (30 µg), Azithromycin (30 µg), Cefixime (5 µg), cCftazidime (30 µg), Ciprofloxacin (5 µg), Co-trimoxazole (30 µg).

Statistical analysis

SPSS version 17 software and SAS software package v.9.2 was used in conducting the analysis of the results. Statistical analyzes were made according to the model of analysis of variance (ANOVA) and the Tukey method of multiple comparisons (or confidence intervals) at the level of significance 0.05. These were done at $p<0.05$ by comparing the means of the variables by applying the Least Significance Difference (LSD) test [22].

Results

The investigation involved 201 pregnant women with urinary tract infection, 95% of the women, they were aged (31-35), while the remaining 5% of the women were aged (36-40). First age bracket recorded the highest frequency of the urinary tract infection and the second age bracket recorded the least. The third is a (Table 1).

Table 1: Rates of urinary tract infections in the age groups studied

Age	n=201	Percentage %
18-30	74	61.66
31-35	33	27.5
36-40	13	10.83

Among 201 pregnant women with diabetes and Urinary tract infections, 120 women (59.7%) were infected with bacteria while 81 (40.3%) were not infected with any bacteria. Among the 210 women infected with the disease, this study observed high incidences of Escherichia coli, 50 (41.6%), Staphylococcus aureus, 25 (20.8%), *Klebsiella pneumonia*,19 (19.8%), Citrobactor spp,16, (13.3) and *Pseudomonas aeruginosa* 10 (8.3%) as shown as in (Table 2).

Table 2: Percentage distribution of the isolated bacteria species

Growth	Frequency	Percentage %
Escherihcia coli	50	41.6
Staphylococcus aureus	25	20.8
*Klebsiella pneumo*niae	19	19.8

Citrobacter spp.	16	13.3
Pseudomonas aeruginosa	10	8.3

The antibiosis sensitivity test demonstrated that single and multiple levels of antibiotic resistance to commonly used drugs were present (Table 3). Nitrofurantoin demonstrated the greatest overall degree of sensitivity (nine; 98.0%) and was followed by antibiotics Gentamycin (nine; 93.0%) against bacterial organisms. In addition, Amikacin ,Cefixime, Levofloxacin , co-trimoxazole, Ceftriaxone and Azithromycin were showed 84.0%, 83.6%, 77.2%, 72.1%, 70.8% and 62.0% sensitivity against different isolates, respectively. However, other tested antibiotics showed lesser than 50% of the sensitivity, such as Ciprofloxacin 47.2% , Ceftazidime 41.3% and Amoxicillin 27.5% while the antibiotic Ampicillin recorded a very low sensitivity 10.9% o against different uropathogens.

Table 3: Antibiotic susceptibility patterns of bacterial uropathogens of pregnant women affected with diabetes mellitus and urinary tract infections

Antibiotics		*E. coli*	*S. aureus*	*K. pneumoniae*	*Citrobacter spp.*	*Psaeruginosa*	Total (%)
Amikacin	S	41	0	17	0	0	58 (84.0)
	R	9	0	2	0	0	11 (15.9)
Amoxicillin	S	20	7	3	5	10	45 (37.5)
	R	30	18	16	11	0	75 (62.5)
Ampicillin	S	8	3	1	0	0	12 (10.9)
	R	42	22	18	16	0	98 (89.0)
Ceftriaxone	S	33	22	18	12	10	85 (70.8)
	R	17	3	1	4	0	25 (20.8)
Azithromycin	S	45	17	2	0	0	64 (68.0)
	R	5	8	17	0	0	30 (31.9)
Cefixime	S	38	21	18	0	10	87 (83.6)
	R	12	4	1	0	0	17 (16.3)
Ceftazidime	S	31	0	12	0	0	43 (41.3)
	R	19	25	7	0	10	61 (58.6)
Ciprofloxacin	S	30	0	6	16	0	52 (47.2)
	R	20	25	13	0	0	58 (52.7)
Cotrimoxazole	S	26	24	15	0	10	75 (72.1)
	R	24	1	4	0	0	29 (27.8)
Gentamycin	S	40	25	15	13	0	93 (84.5)
	R	10	9	4	3	0	26 (23.6)
Levofloxacin	S	48	25	0	12	0	85 (77.2)
	R	2	0	0	4	0	6 (5.4)
Nitrofurantoin	S	43	25	14	16	0	98 (89.0)
	R	7	0	5	0	0	12 (10.9)

Discussion

The findings of this study provide a detailed overview of the bacterial profile and antibiotic susceptibility patterns in pregnant diabetic women suffering from urinary tract infections (UTIs). The predominance of Escherichia coli (41.6%) followed by Staphylococcus aureus (20.8%) and Klebsiella pneumoniae (19.8%) is consistent with recent global surveillance reports, which consistently identify E. coli as the primary pathogen in both community and hospital-acquired UTIs [23]. However, the increased prevalence of Staphylococcus aureus in this specific patient cohort (pregnant women with diabetes) warrants particular attention, as metabolic dysregulation and pregnancy-associated immunosuppression appear to create a unique microenvironment that favors the persistence of Grampositive organisms [24].

Our results indicate that younger pregnant women (18-30 years) exhibit a higher susceptibility to UTIs compared to their older counterparts. This finding is reinforced by current studies highlighting that physiological changes in younger pregnancies, combined with behavioral and lifestyle factors, might influence the urinary tract's natural defense mechanisms [25]. The strong association observed between diabetes and urinary tract vulnerability underscores the critical role of glycemic control [26]. Hyperglycemia-induced glycosuria provides an abundant nutritional source for bacterial growth, while concurrent diabetic autonomic neuropathy can lead to incomplete bladder emptying, further exacerbating the risk of prolonged bacterial colonization [27].

A significant portion of our study focuses on the escalating resistance profiles of these uropathogens. The alarmingly low sensitivity observed for ampicillin (10.9%) and amoxicillin (27.5%) aligns with the global trend of widespread resistance to beta-lactam antibiotics [28]. As noted by Mansouri *et al*., the emergence of multi-drug resistant (MDR) strains in obstetric populations has become a formidable challenge for empirical therapy, particularly when organisms produce Extended-Spectrum Beta-Lactamases (ESBLs) [29].

The fact that our isolates exhibited varying levels of effectiveness against third-generation cephalosporins (e.g., Ceftriaxone at 70.8%) confirms that while some traditional protocols remain partially viable, the rapid shift toward resistant phenotypes in the 2025-2026 period demands a more targeted, precision-based approach [30]. Furthermore, our data demonstrating high sensitivity to Nitrofurantoin (89.0%) and Gentamicin (84.5%) supports their continued relevance as empirical treatment options in this high-risk population [31]. However, caution is advised; as reported by Smith and O'Connor, the over-reliance on these agents in high-risk pregnancies may eventually drive secondary resistance mechanisms [17]. The clinical implications of our

findings are clear: empirical therapy should no longer be based on outdated local guidelines. Instead, it must be integrated with real-time susceptibility surveillance to avoid therapeutic failure, which is especially critical during pregnancy to prevent complications such as preterm labor and neonatal sepsis [32].

The limitation of our study, namely the inability to distinguish between type 1 and type 2 diabetes mellitus, represents an area for future investigation. Emerging research suggests that the metabolic pathways influencing immune responses differ significantly between these diabetes types, which in turn might dictate different bacterial colonization patterns [33]. Consequently, future studies should implement standardized glycemic monitoring protocols to better correlate infection severity with metabolic stability [34]. This research highlights an urgent need for an paradigm shift in how we manage UTIs in pregnant diabetics. The shift toward targeted therapy, supported by rapid diagnostic methods, is not just beneficial—it is a medical necessity to protect the health of both mother and child in an era of increasing antibiotic resistance [35].

Conclusion

As evidenced from this study, antibiotic sensitivity should have been done prior to starting antibiotics amongst pregnant diabetic women with UTI. These results will also be useful in developing protocols for administering antibiotics to this category of patients.

Recommendation

Even though certain limitations of the present study can be pointed out, these did not impose a serious influence to the overall conclusions made. Diabetes cases were not differentiated by type; thus involves both type 1 and type 2 diabetes. Subsequent researches may consider it and assert the presence of links with mentioned classes.

Ethical Approval

The study was conducted following ethical approval from the Scientific Research Ethics Committee at the Teaching Hospital in Maysan (Protocol EC73, dated February 9, 2025). Verbal consent was obtained from all patients participating in the study.

Conflict of Interest

There are no conflicts of interest regarding this article.

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